Digitized by the Internet Archive
in 2025

https://archive.org/details/manualsplus_09706

1427

INSTRUCTION MANUAL

MODEL 1910
DISPLAY
OSCILLOSCOPE

CAL
LAB

WAVETEK® INDIANA INC.

66 N. 1st AVENUE, P.O. BOX 190
BEECH GROVE, INDIANA 46107
317—783-3221

INSTRUCTION MANUAL

MODEL 1910
DISPLAY
OSCILLOSCOPE

WAVETEK® INDIANA INC.

66 N. 1ST AVENUE, P.O. BOX 190

BEECH GROVE, INDIANA 46107

317—783-3221

WARRANTY

All Wavetek instruments are warranteed against defects in material and workmanship for a period of one year after date of manufacture. Wavetek agrees to repair or replace any assembly or component (except batteries) found to be defective, under normal use during this period. Transfermatic Switch assemblies, manufactured by Wavetek, are unconditionally warranteed for the life of the instrument. Wavetek's obligation under this warranty is limited solely to repairing any such instrument which in Wavetek's sole opinion proves to be defective within the scope of the warranty when returned to the factory or to an authorized service center. Transportation to the factory or service center is to be prepaid by purchaser. Shipment should not be made without prior authorization by Wavetek.

This warranty does not apply to any products repaired or altered by persons not authorized by Wavetek, or not in accordance with instructions furnished by Wavetek. If the instrument is defective as a result of misuse, improper repair, or abnormal conditions or operations, repairs will be billed at cost.

Wavetek assumes no responsibility for its product being used in a hazardous or dangerous manner either alone or in conjunction with other equipment. High voltage used in some instruments may be dangerous if misused. Special disclaimers apply to these instruments. Wavetek assumes no liability for secondary charges or consequential damages and, in any event, Wavetek's liability for breach of warranty under any contract or otherwise, shall not exceed the purchase price of the specific instrument shipped and against which a claim is made.

Any recommendations made by Wavetek for use of its products are based upon tests believed to be reliable, but Wavetek makes no warranty of the results to be obtained. This warranty is in lieu of all other warranties, expressed or implied, and no representative or person is authorized to represent or assume for Wavetek any liability in connection with the sale of our products other than set forth herein.

This document contains information proprietary to Wavetek. The information in this document is not to be used or duplicated in any manner without the prior approval in writing of Wavetek.

CONTENTS

SECTION 1 - GENERAL INFORMATION
- 1.1 INTRODUCTION
- 1.2 SPECIFICATIONS
- 1.3 ACCESSORIES

SECTION 2 - OPERATING INSTRUCTIONS
- 2.1 INTRODUCTION
- 2.2 INITIAL INSPECTION
- 2.3 DESCRIPTION OF FRONT PANEL
- 2.4 DESCRIPTION OF REAR PANEL
- 2.5 GENERAL OPERATION
- 2.6 RACK MOUNTING

SECTION 3 - CIRCUIT DESCRIPTION
- 3.1 INTRODUCTION
- 3.2 SIMPLIFIED BLOCK DIAGRAM
- 3.3 POWER SUPPLY
- 3.4 HIGH VOLTAGE POWER SUPPLY
- 3.5 VERTICAL AMPLIFIER
- 3.6 HORIZONTAL AMPLIFIER
- 3.7 CATHODE AND GRID CIRCUITS
- 3.8 CATHODE RAY TUBE

SECTION 4 - MAINTENANCE
- 4.1 INTRODUCTION
- 4.2 SERVICE INFORMATION
- 4.3 PERFORMANCE CHECKS
- 4.4 CALIBRATION PROCEDURE
- 4.5 TROUBLESHOOTING

SECTION 5 - SCHEMATICS AND PARTS LISTS

CHANGE INFORMATION, IF ANY, IS LOCATED AT THE REAR OF THIS MANUAL.

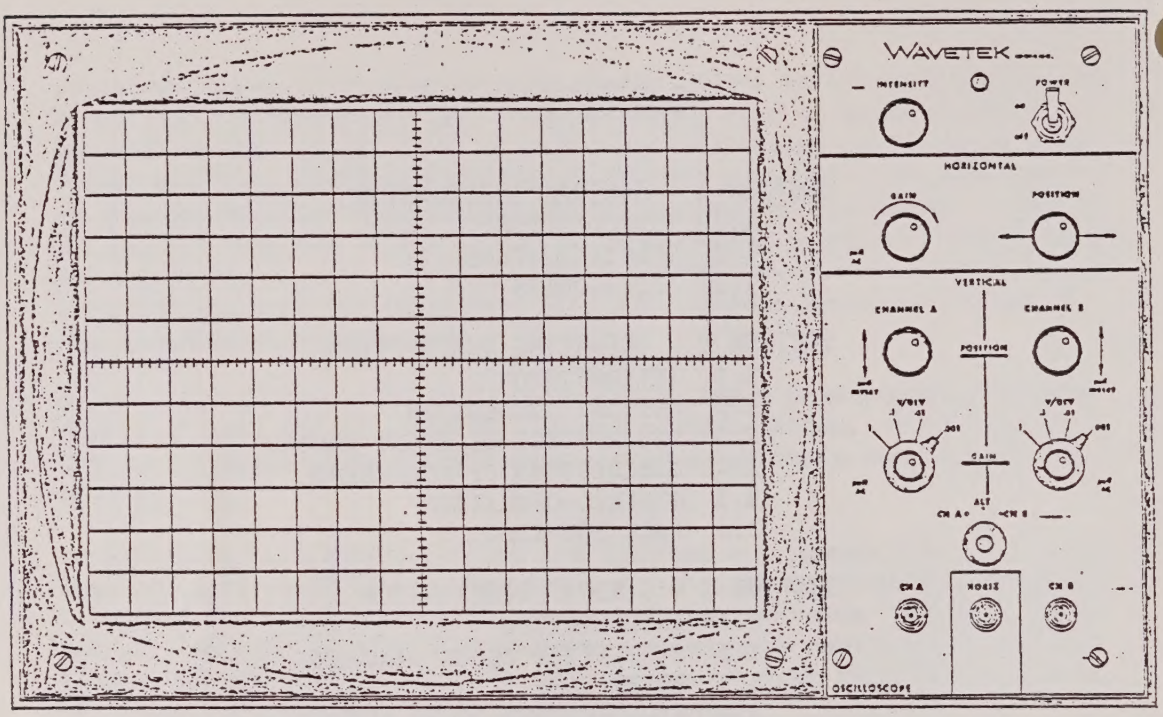


FIGURE 1 WAVETEK DISPLAY OSCILLOSCOPE

SCOPE OF THIS MANUAL

This manual provides descriptive material and instructions for the installation, operation, maintenance, and repair of the WAVETEK Model 1910 Display Oscilloscope.

SECTION 1
GENERAL INFORMATION

1.1 INTRODUCTION

The Wavetek Model 1910 is a large screen, dual trace, solid state, X-Y display oscilloscope designed for production and laboratory test systems which employ sweep generator techniques.

For these applications, several features have been incorporated in this large easy to read display.

1. Z axis marker circuit with an intensity control independent of the front panel control.
2. Y axis marker adder circuit.
3. Vertical polarity reversal.
4. Spot blanking circuit to prevent burning of the CRT phosphor.

The Model 1910 can also be used in many general purpose applications where a large screen X-Y display oscilloscope is required.

Features important in the display for these applications are:

1. Excellent full scan linearity.
2. High vertical sensitivity, up to 1 mV/division.
3. Ultra stable, low noise display.
4. Molded graticule for minimum paralax.

The Model 1910's most outstanding feature is its mechanical strength and electrical reliability. In the event servicing is required in the field, maintenance personnel will find that the unit's single P.C. board construction, organized component layout, plus a comprehensive instruction manual all contribute in making this instrument easy to service, even for the relatively inexperienced technician.

1.2 SPECIFICATIONS

DISPLAY		
CRT		12" diagonal (30cm)
Phosphor		P1 Medium persistence - Green
	OPT A	P4 Medium short persistence - White
	OPT B	P7 Long persistence - Blue
Graticule		12 vertical-16 horizontal division (1.5cm/div)
	OPT C	Clear face plate (no graticule)
	OPT D	Amber filter - mounts between tube and face plate, normally used with P7 phosphor.
Deflection		Magnetic
Accelerator Voltage		9 kV nominal
VERTICAL (each channel)		
Sensitivity		4 position step attenuator for 1 mV/div., 10 mV/div., 100 mV/div., and 1 V/div. Continuously variable vernier between steps.

1.2 SPECIFICATIONS (Cont'd)

Input Impedance	374 Kilohm
Bandwidth	DC to 15 kHz (10 div. amplitude)
Linearity	5% (center 10 div.)
Coupling	Switchable AC-DC (when AC coupled max DC voltage plus AC peak not to exceed 200V).
Input Connector	BNC, front panel
Drift	Less than ½ div/8 hr. (at a constant ambient after ½ hour warm up).
Polarity Reverse	Vertical signal can be inverted with front panel switch.

MARKER ADDER

Input Signal	Pulse or birdy
Sensitivity (Max)	.5 V/Division - continuously adjustable with rear panel control.
Polarity	Rear panel polarity reversal switch.
Input Impedance	Approximately 15 Kilohm

HORIZONTAL

Sensitivity	Continuously adjustable from .1 V/Division to over 10 V/Division.
Input Impedance	Greater than 320 Kilohm
Bandwidth	DC to 1.5 kHz (14 div. amplitude)
Linearity	3% (16 div.)
Coupling	Switchable AC-DC (when AC coupled, max. DC voltage plus AC peak not to exceed 200 V)
Input Connector	BNC, front panel
Drift	Less than ½ div/8 hr. (at a constant ambient temperature after ½ hour warm up).

PROTECTION CIRCUIT	Prevents burning of the CRT by blanking the beam when the horizontal signal is less than approximately 4 divisions (60 Hz rate). When operating at a slower rate, or for servicing, a rear panel switch can be used to eliminate the protection circuit.

INTENSITY MODULATION

Sensitivity	±2 V pulse will produce a bright spot on the display.
Input Impedance	10 Kilohm
Intensity Adj.	Separate rear panel control adjusts intensity of Z input, independent of front panel intensity control.
Input Connector	BNC, rear panel
R	115/230 VAC ±10% 50/60 Hz (approximately 75W)

1.2 SPECIFICATIONS (Cont'd)

OPERATING TEMPERATURE	+10° to +50°C
MECHANICAL	
Dimensions	10 5/16" (26.2cm) high x 14½" (36.8cm) long x 16½" (41.9cm) wide
Weight	26 pounds (11.8 Kg)

1.3 ACCESSORIES

ACCESSORIES INCLUDED	Operating Instruction Manual
ACCESSORIES AVAILABLE	Rack Mounting Kit, K107 Spare face plate without graticule Spare face plate with graticule

SECTION 2
OPERATING INSTRUCTIONS

2.1 INTRODUCTION

This section provides information for initial inspection, front and rear panel description, rack mounting and typical operating instructions.

2.2 INITIAL INSPECTION

After unpacking, the instrument should be inspected for physical damage. A procedure for checking the electrical performance is given in Section 4. The shipping container and the packing material should be saved in case it becomes necessary to reship the unit.

If there is physical damage or the unit does not meet the electrical performance checks, notify the nearest Wavetek area representative or the factory in Indiana. If the shipping container shows damage, notify the carrier. Retain the shipping container and packing material for the carrier's inspection. In either case, the factory or area representative will arrange for immediate repair or replacement of your instrument, without waiting for damage claim settlements.

2.3 DESCRIPTION OF FRONT PANEL

See Figure 2-1 for location of front panel controls.

(1) INTENSITY . . . Controls the brightness of the display.

(2) POWER . . . Toggle switch applies primary power to the instrument. The LED pilot light indicates an operating condition.

(3) HORIZONTAL POSITION . . . Controls the horizontal position of the trace.

(4) VERTICAL POSITION . . . Controls the vertical position of the trace.

(5) VERTICAL GAIN . . . V/Div selects the vertical amplifier deflection factor. The vernier control provides a continuously variable adjustment between the ranges of the

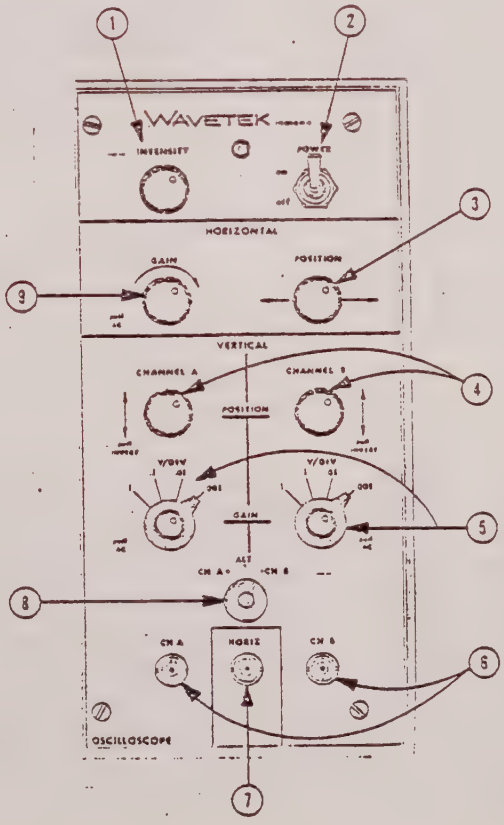


Figure 2-1. Front Panel

V/Div switch (vernier must be fully clockwise to indicate a calibrated deflection factor). Input coupling of the vertical signal is normally DC. Pulling out on the vernier control will provide AC coupling of the input signal.

(6) CH A, CH B . . . BNC connectors accept the vertical input signals.

(7) HORIZ . . . BNC connector accepts the horizontal input signal.

(8) . . . . . Channel selector allows operator to display channel A, channel B or both. The ALT position causes both channels to be displayed alternately at half of horizontal input frequency.

(9) HORIZONTAL GAIN . . . Vernier control provides a continuously variable adjustment of the horizontal input signal. Input coupling of the horizontal signal is normally DC. Pulling out on the vernier control will provide AC coupling of the input signal.

2.4 DESCRIPTION OF REAR PANEL

See Figure 2-2 for locations of rear panel devices.

(1) AUTO BLANK . . . In the ON position the Auto Blanking circuit blanks the CRT beam in the absence of a horizontal signal to prevent burning of the CRT phosphor. In the OFF position, the blanking circuit is disabled to allow operation at slow sweep rates or to aid in servicing. WARNING: Caution must be observed when switch is in the OFF position to prevent burning of the CRT phosphor.

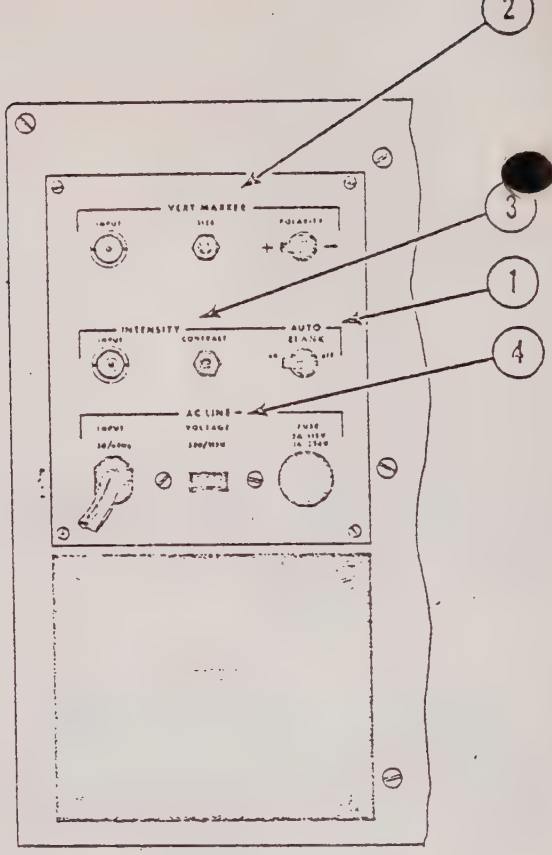


Figure 2-2. Rear Panel

(2) VERT MARKER . . .

INPUT - BNC connector for connection to a marker source. Markers may be either pulse or birdy type.

SIZE - This control provides continuous adjustment of the marker size. Maximum sensitivity is .5 volts per division.

(+/-) - This switch provides inversion of the vert. marker signals.

(3) INTENSITY . . .

INPUT - BNC connector for connection to a pulse marker source. A positive or negative pulse with an amplitude of 2 to 20 volts will produce a bright spot (pin ball) on the display.

CONTRAST - This control adjusts the intensity of the Z marker. The marker intensity is independent of the input amplitude or the setting of the front panel intensity control.

(4) AC LINE . . .

INPUT - 3 prong AC plug provides connection to AC mains.

VOLTAGE - Switch selects 115 or 230 VAC line voltage.

FUSE - 3 AG type, slo-blo, 2 amp for 115 VAC or 1 amp for 230 VAC.

2.5 GENERAL OPERATION

When initially setting up the instrument, check the rear panel AC LINE VOLTAGE switch and the fuse to insure that the instrument is set to operate with the available voltage.

This instrument is ideal for use in conjunction with a Wavetek sweep generator. The vertical and horizontal amplifier specifications are very compatible with the signals that generate a demodulated RF response. The Y and Z marker inputs can be used conveniently with the various marker signals from the sweep generator. Consult the sweep generator manual for specific hookup instructions.

Applications for this instrument are certainly not limited to use with sweep generators. Any instrumentation requiring a large screen, X-Y display scope can include this unit.

This unit will meet it's specifications over a temperature range of +10° to +50° C. When unit is turned on, it is ready for use without a warmup period.

When the scope is being used in the ALT mode the channel normally changes at the positive peak of the horizontal input.

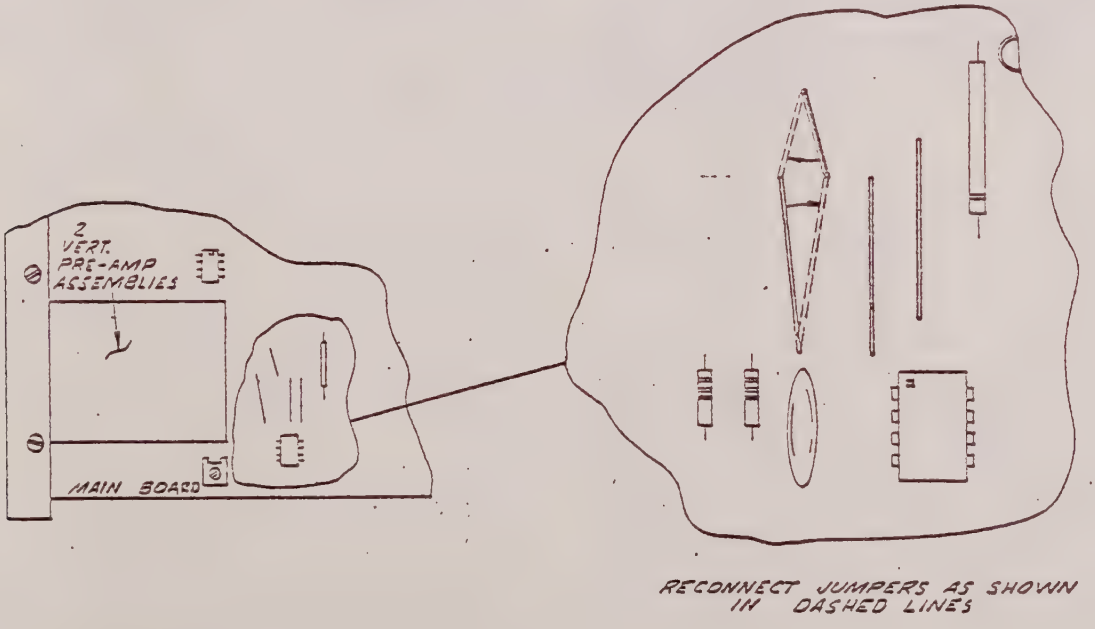


Figure 2-3. Channel Switching Point Modification

If this is inconvenient for a particular application, the switching point can be changed to coincide with the negative peak of the horizontal input signal by reversing the two jumper wires as shown on sheet 2 of 3 of the schematic diagram.

This is illustrated in Figure 2-3.

2.6 RACK MOUNTING KIT, K107

This kit makes it possible to mount the display scope in a standard 19" wide instrument rack. The kit consists of two aluminum brackets which fasten to the sides of the instrument as shown in Figure 2-4.

The necessary screws are located in the pre-drilled holes provided for this accessory.

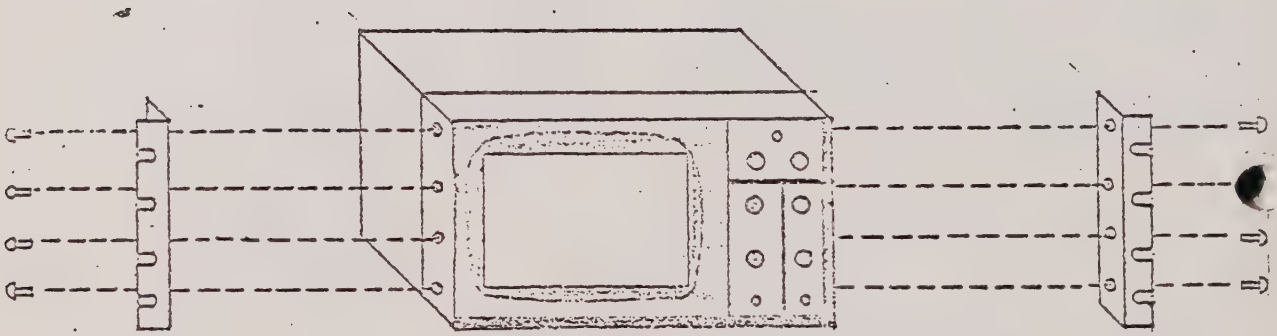


Figure 2-4. Display Scope Rack Mounting

SECTION 3
CIRCUIT DESCRIPTION

3.1 INTRODUCTION

This section first presents an overall block diagram analysis followed by a more detailed description of each block.

Figure 4-6 is a "top view" drawing of the Display with the main sections labeled. This will serve as a physical reference corresponding to the circuit description.

3.2 SIMPLIFIED BLOCK DIAGRAM

The block diagram of Figure 3-1 shows the relationship of each main section to the total operation of the unit. The CRT (Cathode Ray Tube) is the heart of the display. The composite signal of all the inputs to the unit is displayed on the face of the CRT.

The Power Supply provides the unit with five voltage sources. The +56 and ±15.5 volt supplies are regulated. The ±32 volt supplies are unregulated.

The High Voltage supply provides +9 kV to the anode of the CRT. The power source for this section is the +32 volt supply. The High Voltage supply also provides positive voltages for G2 and G4, (the focusing electrode), of the CRT.

The Vertical Amplifiers convert the input voltage signals into a current signal for the vertical deflection yoke. The vertical amplifiers have front panel controls for adjusting the GAIN and POSITION of the vertical displays on the CRT. This section also has the capability of adding vertical ("Y") markers to the scope display. These markers can indicate an exact point on the display as a reference for the operator. The vertical signals can be inverted with the VERT POLARITY switches.

The Horizontal Amplifier converts the input voltage signal to a corresponding current signal for the Horizontal Yoke on the CRT. The Horizontal Amplifier has front panel controls for adjusting the GAIN and POSITION of the horizontal display on the CRT.

The Cathode and Grid drivers include the display INTENSITY control and the "Z" marker input and intensity control. There is also an automatic blanking signal which turns the scope intensity off when horizontal signal becomes small enough to damage the CRT phosphor.

3.3 POWER SUPPLY

The outputs are +56 V and ±15.5 V regulated DC, as well as ±32 V unregulated DC.

A dual primary transformer, T401, allows for a line voltage of either 115 V or 230 V AC. The 50 V secondary is center tapped to allow for two full wave rectified voltages. Unregulated +32 and -32 are filtered by C403 and C404 respectively. The +15.5 and -15.5 supplies are powered by the ±32 volt supplies. They are zener diode regulated and have pass transistors for higher output current capability.

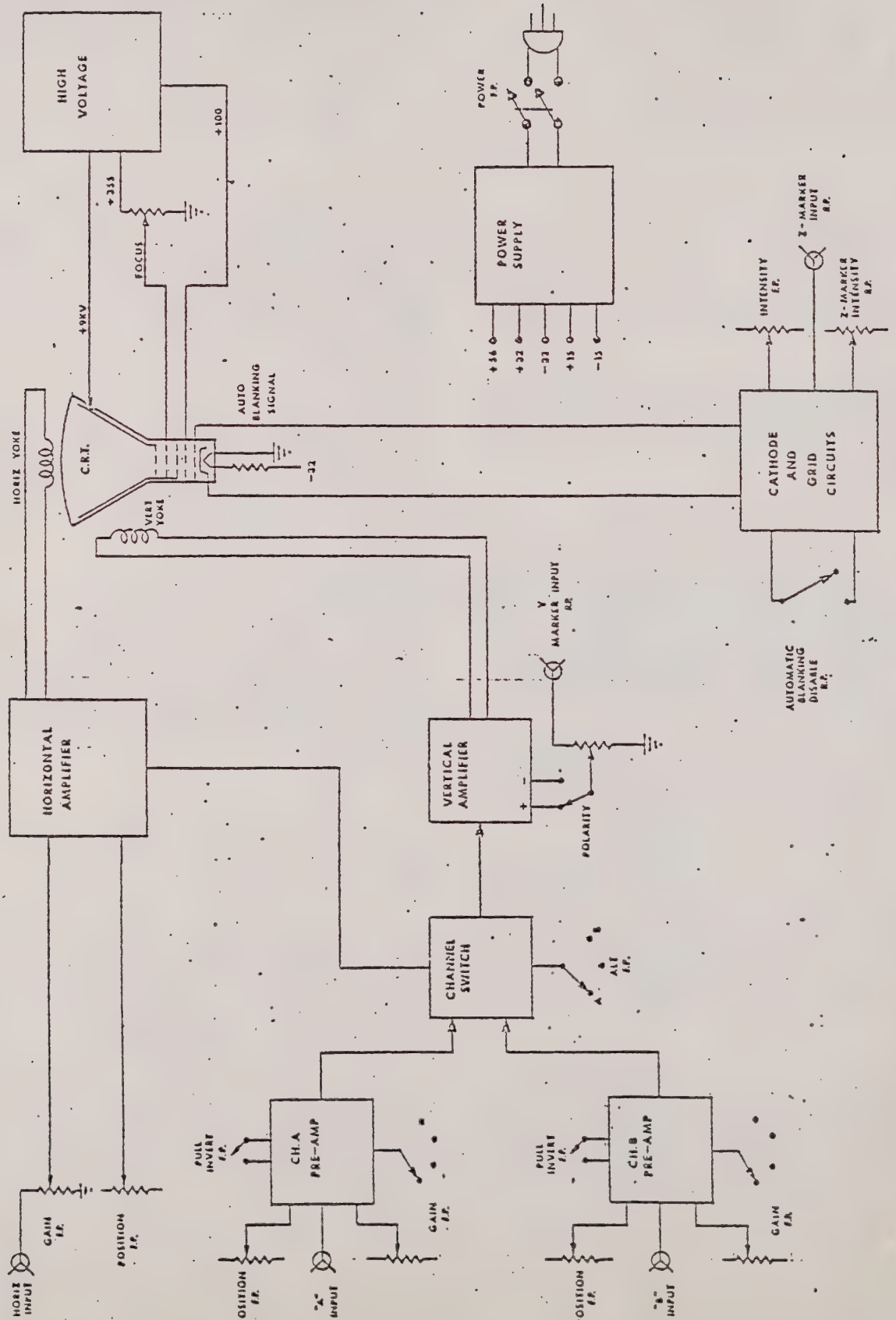


Figure 3-1. Block Diagram

The source of the +56 V supply is approximately +96 volts derived from a voltage divider stacked on top of the +32 V supply. The +56 volts is regulated by a zener diode (CR236). In order to minimize random changes in brightness of the displayed signal, the front panel INTENSITY control is the only load on the +56 volt supply.

3.4 HIGH VOLTAGE SUPPLY

The High Voltage circuit is located away from the main printed circuit board (See Figure 4-6) and housed in a steel enclosure to prevent 20 kHz radiation. The high voltage circuit contains Q501, Q502 and Q503. It provides 9 kV to the CRT anode as well as +355 V for the focusing electrode (G4) and +100 V for G2. Q503 is the heart of a ringing choke oscillator that develops a 20 kHz signal across T501. This voltage is coupled to the two different high voltage circuits. The oscillator signal is stepped up from 17 Vp to 2.25 kVp in the secondary connected to C508. It is then increased to +9 kV DC by the cascade quadrupler. The oscillator signal is stepped up to 355 Vp in the other secondary and rectified by CR503 and C507. The 355 volts is then fed to the focus control, R303. The 100 volt supply is derived from a voltage divider on the 355 volt output.

Q501 and Q502 provide the supply voltage to the oscillator. This voltage is varied by a feedback signal in order to maintain a constant output level from the oscillator. The feedback is taken from R509 which is also the High Voltage adjustment. As the 9 kV supply is loaded, a bigger load is seen by the oscillator. This temporarily lowers the oscillator supply voltage, consequently coupling less voltage to the 355 V circuit. This results in a lower voltage at R509. This is inverted and amplified to provide a larger voltage supply to the oscillator, thus correcting for the additional loading.

3.5 VERTICAL AMPLIFIER

The Vertical Amplifier section consists of four sections: two preamps, a switching circuit and the power amplifier.

The Vertical Pre-Amplifiers are mounted on separate boards and installed on the FRONT PANEL directly behind the vertical input jacks. The power for these stages is ±6 V. These voltages are derived from two zener diode regulators connected to the +15.5 volts and -15.5 volts.

The vertical input impedance is 374 K ohm in parallel with 20 pF determined by R109 and C105. The signal first goes through one half of Q101, a dual FET. The vertical DC balance is adjusted at the gate of the other half. Q101 acts as a current offset compensation device for IC101. IC101 is an op. amp. with a gain which is determined by switched feedback resistors R101 through R104. S102 is the GAIN switch on the front panel which can select a sensitivity of 1, .1, .01 or .001 volts/division. The front panel vertical GAIN control, R116, adjusts the input voltage to the next stage, IC102A.

The gain calibration pot, R105, adjusts the negative feedback of the inverting op. amp., IC102A. IC102B is normally a non-inverting amplifier with a gain of about one. When pin 5 is grounded by the PULL INVERT switch, S402 or S408, this stage becomes an inverting amplifier with a gain of one. Thus the scope display will be inverted. The output of this stage then goes to the channel selecting circuit.

The signals from the front panel VERTICAL POSITION controls are added to their corresponding preamp outputs at this point.

The channel selecting circuit includes the voltage controlled switch and the switch drive circuit.

4.1 INTRODUCTION

This section provides information for performance testing, calibration, and troubleshooting the Wavetek Display. The performance test is designed for incoming inspection and periodic evaluation. If performance is not to specifications, refer to the calibration and troubleshooting sections.

4.2 SERVICE INFORMATION

4.2.1 Disassembly Information

The only disassembly required for any servicing is removing the "U" frame cover removing the high voltage from its

To remove "U" frame dust cover, there are 3 screws on each side of the unit which must be removed. Then move cover toward rear of unit and lift off.

To remove the high-voltage circuit from its metal box, there is one horizontal screw on each side of the lid which must be removed. DO NOT remove screws or nuts on top of lid. The circuitry is mounted on the lid and will be removed from the box when the lid is lifted straight up.

4.2.2 Transistor and IC Lead Configurations

Due to the many variations in lead configurations, Figure 4-1 shows the lead arrangement for the transistors and IC's used in this unit.

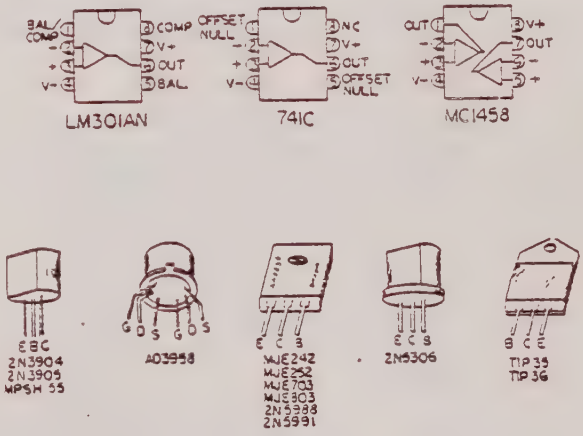


Figure 4-1. Lead Configurations

TABLE 4-1. RECOMMENDED TEST EQUIPMENT

INSTRUMENT	CRITICAL REQUIREMENTS	RECOMMENDED
Oscilloscope	Lab grade, D.C. coupled	Tektronix 5103N with D10 main frame 5A18N Vertical Amp 5B10N Time Base
Voltmeter	10 Megohm input impedance	Weston Model 4440

TABLE 4-1. Continued

INSTRUMENT	CRITICAL REQUIREMENTS	RECOMMENDED
Function Generator	2 independent frequency outputs.	Wavetek Model 144
HV Probe	300 Megohm input impedance	Pomona Model 3157 High Voltage test probe

4.3 PERFORMANCE CHECKS

The following procedure is intended to insure that the instrument meets its published specifications. The equipment needed to perform the following tests is as follows: 1 Wavetek Model 144 function generator (or 2 audio frequency function generators) and 1 general purpose oscilloscope.

The instrument controls should be set as follows: POWER off, INTENSITY minimum (fully ccw), Horizontal and Vertical POSITION controls to mid position (indicator pointing up), Horizontal GAIN to mid range, Vertical GAIN switch to 1 V/div and vernier fully clockwise. The rear panel AUTO BLANKING switch should be in the NORM position.

Switch the POWER on and allow a 5 minute warmup before proceeding.

4.3.1 Vertical POSITION Control Check

Apply an AC signal to the Horizontal input. Approximately 4 volts p-p will extend the full width of the scope face with GAIN set at mid range. Turn INTENSITY up until trace appears.

Select Channel A. Turning the Vertical POSITION control should position the line off the screen in both directions. Return the control to mid position to center the line. Repeat for channel B.

4.3.2 Horizontal POSITION Control Check

Apply an AC signal to the Vertical input. Approximately 12 volts p-p will extend the full height of the scope face with VERT GAIN control set as indicated above. Switch the AUTO BLANKING switch on the rear panel to the OFF position. DO NOT turn AUTO BLANKING off without a signal to the scope Vertical. The result would be a bright dot which would burn the CRT phosphor. Turning the Horizontal POSITION control should position the line off the screen in both directions. Return the control to mid position to center the line. Switch the AUTO BLANKING switch to the NORM position. The line should disappear from the tube face.

4.3.3 Vertical Gain Check

Connect the Display as shown in Figure 4-2. Set the function generator controls as follows: Frequency to 1 kHz, adjust the output of the generator for a 10 V p-p signal. This amplitude is set using the calibrated scope in the test setup. Adjust the function generator for a continuous sweep output, approximately 10 milliseconds in duration (or set a second generator for about 100 Hz).

Adjust the Horizontal GAIN and the Vertical and Horizontal POSITION controls for a pattern similar to Figure 4-3. The amplitude on the display should be 10 divisions ±1 division on both channels A and B.

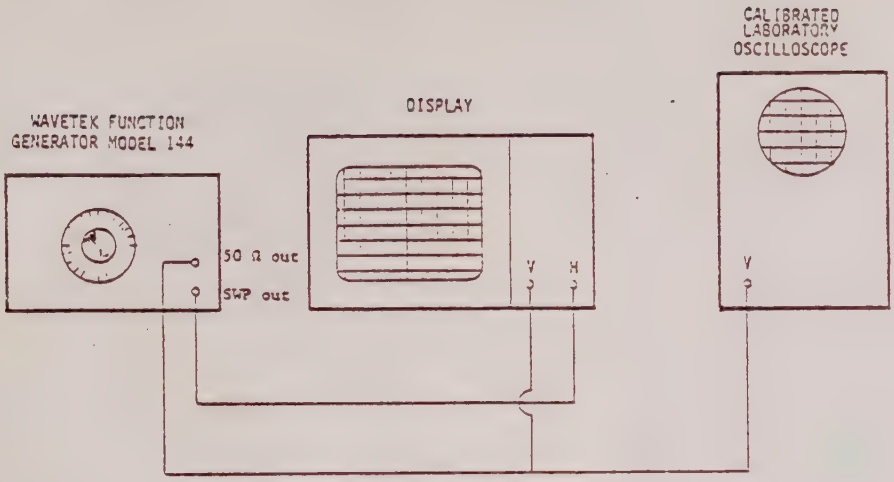


Figure 4-2. Vertical Gain Check Hookup

4.3.4 Vertical Bandwidth Check

Maintaining previous hookup, set Vertical frequency for 1 kHz at 10 vertical divisions on channel A. Increase the frequency of the function generator to [illegible] kHz. The display amplitude should be at least 7 divisions in amplitude (3 dB point). Repeat for channel B.

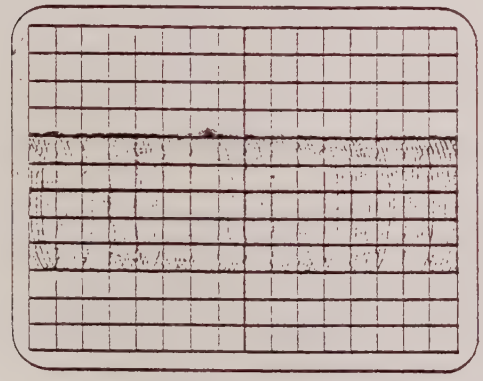


Figure 4-3. Vertical Gain Check

4.3.5 Vertical Linearity Check

[illegible]uce the frequency of the function generator to 1 kHz. Switch the V/div switch to 1 V/div and turn the vernier GAIN control fully clockwise. Reduce function generator to 1 V p-p (1 division on the scope face). This one volt reference should be set up on the center of the Display. Using the Vertical POSITION control, move this one volt reference up and down. It's amplitude should not vary more than 5%.

4.3.6 Horizontal Gain Check

Reduce the frequency of the function generator to 100 Hz. The output of the generator should still be 1 V p-p. Reverse the Horizontal and Vertical connections to the Display. Adjust the Horizontal and Vertical controls on the Display to produce a pattern similar to Figure 4-4. Turn AUTO BLANKING off. Turn the Horizontal GAIN control from min to max. The pattern should go from 0 deflection to greater than 10 divisions.

4.3.7 Horizontal Bandwidth Check

Using the output control on the function generator and the Horizontal GAIN control on the Display, adjust the pattern until it is 14 divisions wide. Increase the frequency of the function generator to 1.5 kHz. The display amplitude should

be at least 9.8 divisions wide (3 dB point).

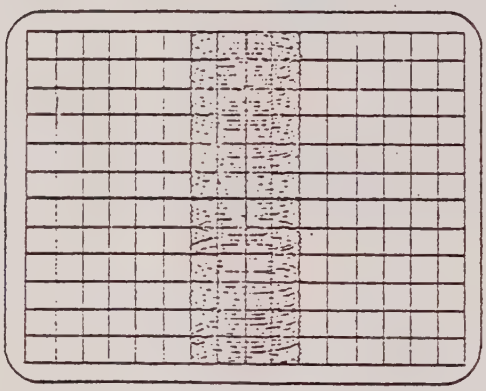


Figure 4-4. Horizontal Gain Check

4.3.8 Horizontal Linearity Check

Reduce the frequency of the function generator to 100 Hz. Adjust the amplitude of the horizontal display until it is one division wide in the center of the Display. AUTO BLANKING will again have to be turned off temporarily.

Move the displayed pattern from left to right over the full 16 divisions. Its amplitude should not vary more than 3%.

After completing the above check, return the AUTO BLANKING switch to the NORM position.

4.3.9 Vertical Polarity Check

Apply an AC signal to scope Horizontal in order to produce a horizontal line. Apply a positive DC voltage to channel A Vertical input to cause the line to move to the upper half of the scope face. Switch the VERT POLARITY switch to the INVERT position. The line on the screen should now be in the lower half of the scope face. Return switch to NORM. Repeat for channel B.

4.3.10 Channel Selector Check

Apply an AC signal to the Horizont input. Set channel selector to channel A. Adjust POSITION control for a trace on the upper half of the screen. Set channel selector to channel B. Adjust POSITION control for a trace on the lower half of the screen. Set channel selector to ALT. Observe that both traces are alternately displayed. Return to channel A.

4.3.11 "Y" Marker Input Check

Apply an AC signal of about 100 Hz to the Horizontal input of the scope. Apply a 5 kHz signal of approximately 5 volts p-p to the "Y" marker input. Rotating the "Y" marker SIZE control should allow a signal to be displayed which is variable from zero to 12 divisions.

4.3.12 "Z" Marker Check

Apply an AC signal to scope Horizontal Apply pulses to the "Z" marker input o at least two volts amplitude and 10 microseconds duration. These should appear as bright dots on the line when the marker INTENSITY control is fully clockwise. The dot's brightness should diminish when the control is fully counterclockwise.

4.4 CALIBRATION PROCEDURE

Remove top cover by removing 3 screws on each side of chassis which hold black "U" frame cover to chassis.

In general, calibration must be performed in sequence given.

Before turning POWER on, there are several steps to perform. Remove High Voltage circuit from box by removing horizontal screw from both sides of lid and lifting lid straight up. The High Voltage circuit is connected to the lid. Place this assembly on bench, taki

care not to short it to the Display chassis.

With unit POWER off, turn INTENSITY fully counterclockwise, switch rear panel switches to NORM position. Plug line cord into autotransformer set at exactly 115 volts. Turn POWER on and allow a 5 minute warmup period before calibrating.

4.4.1 Power Supply Checks

See Figure 4-5 for location of test points (T.P.).

With lab grade oscilloscope, check ±32 V at T.P. 1 and 2 (Figure 4-5). With Vertical POSITION control fully clockwise, the +32 V should be +33 volts ±.5 V, the -32 supply should be -31 V with ±1 V ripple. With the Vertical POSITION control fully counterclockwise, the +32 supply should be +31 V ±1 V ripple, the -32 supply should be -33 V ±.5 V.

With the voltmeter, check + and -15.5 V supplies at T.P. 3 and 4. These should be within 5% of nominal value. Check +56 V at T.P. 5; this should be within 10% of nominal value.

4.4.2 High Voltage Adjustment

With high impedance (10 Meg) meter, set +355 volt supply at T.P. 6 with trimmer pot R509 on High Voltage printed circuit board.

With meter, check +100 V supply at T.P. 7; this should be ±5%. Check +9 kV ±500 V with High Voltage probe, by sliding probe under High Voltage connector cover on CRT anode (Figure 4-6).

4.4.3 Intensity Limit & Focus Adjustment

Apply square wave to Vertical input and a ramp to Horizontal input. Adjust ramp for a stable square wave pattern.

Set INTENSITY fully clockwise. Adjust sc( )controls for a pattern 10 divisions hig.. by 12 divisions wide. Turn INTENSITY LIMIT control, Adj 1, (Figure 4-5) fully clockwise. Return counterclockwise until blooming is 1%. This can be determined by allowing the vertical amplitude to increase from 10 to 10.1 divisions. Now adjust focus control, Adj 2, (Figure 4-5) for sharpest display.

4.4.4 Vertical D.C. Balance

Apply an AC signal to the Horizontal input. Turn the INTENSITY up until trace is visible. A signal approximately 4 V p-p will extend the full width of the scope when GAIN is set at mid range. Select channel A. Set Vertical GAIN switch to 1 V/div. Set Vertical GAIN vernier fully counterclockwise. Position horizontal line at center graticule with Vertical POSITION control. Turn Vertical GAIN vernier fully clockwise. With Adj 5 (Figure 4-5), return line to center graticule.

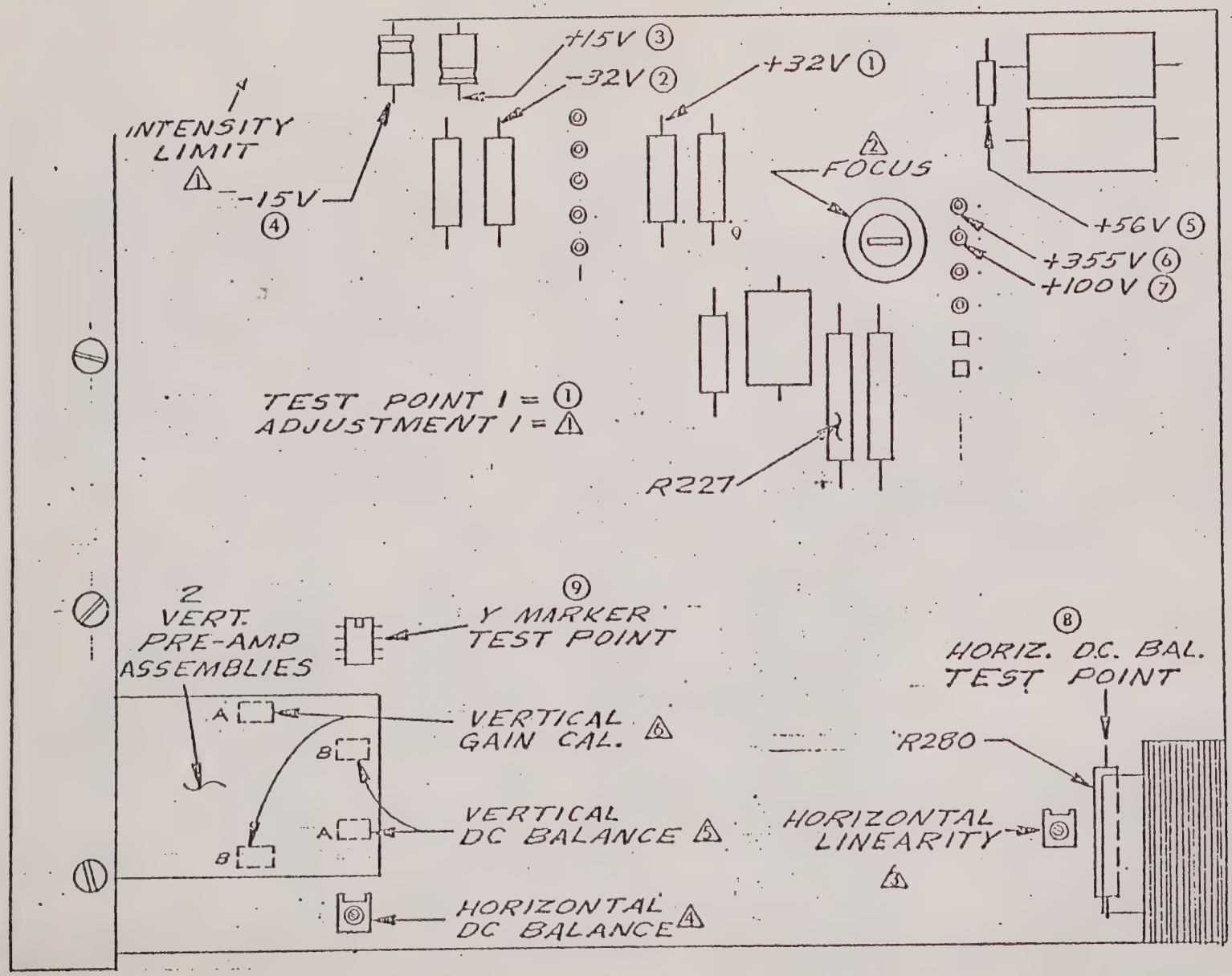
Start procedure again by turning Vertical GAIN vernier fully counterlcockwise. Repeat procedure until there is minimum movement of the line when the Vertical GAIN vernier is turned from one extreme to the other. Repeat procedure for channel B.

4.4.5 Vertical GAIN Calibration

Maintain setup of section 4.4.3. Set channel A Vertical GAIN vernier fully clockwise. Apply a 1 kHz signal simultaneously to the Vertical input and the Vertical input of a lab grade scope. Adjust signal generator to 8 V p-p according to the lab scope. Adjust Adj 6 (Figure 4-5) for 8 divisions on Display face. Repeat for channel B.

4.4.6 Horizontal D.C. Balance

Remove signal from Horizontal input. Set Horizontal POSITION control for zero volts on wiper using sensitive scale (50 mV/div) on lab scope. Connect lab scope to T.P. 8. Set this voltage to zero volts with Adj 4.


+15V ③
-32V ②
+32V ①
INTENSITY LIMIT ⚠1
-15V ④
⚠2 FOCUS
+56V ⑤
+355V ⑥
+100V ⑦
TEST POINT 1 = ①
ADJUSTMENT 1 = ⚠1
R227
2 VERT. PRE-AMP ASSEMBLIES
⑨ Y MARKER TEST POINT
⑧ HORIZ. D.C. BAL. TEST POINT
A
B
VERTICAL GAIN CAL. ⚠6
VERTICAL DC BALANCE ⚠5
R280
HORIZONTAL LINEARITY ⚠3
HORIZONTAL DC BALANCE ⚠4

4.4.7 Yoke Adjustment

1[illegible] INTENSITY fully counterclockwise. Disconnect any signals from scope inputs. Both POSITION controls should still be at mid range. Connect DC voltmeter across Horizontal yoke. This is in parallel with R280 (Figure 4-5). Set voltmeter to sensitive (2.5 V) scale and adjust Horizontal POSITION control until meter reads zero volts. Next, connect voltmeter across Vertical yoke. This is in parallel with R227 (Figure 4-5). Adjust vertical POSITION control until meter reads zero volts.

Turn AUTO BLANKING Off and turn up INTENSITY carefully until a very faint dot is seen. (A bright spot on scope face will damage the CRT phosphor.) Adjust two tabs on yoke until dot is exactly centered. Return AUTO BLANKING to NORM position.

Apply an AC signal to the Horizontal in[illegible] A signal approximately 4 V p-p [illegible] extend the full width of the scope when the Horizontal GAIN is at mid range. Center trace both vertically and horizontally with POSITION controls. Loosen yoke clamp screw until yoke is free to rotate. Rotate horizontal line until it is exactly parallel to the center horizontal graticule. Tighten screw and recheck trace alignment.

4.4.8 Vertical Linearity Check

Apply an AC signal to scope Horizontal so that line extends exactly 16 divisions. Set Vertical GAIN to 1 V/div. Adjust Vertical POSITION control until line exactly coincides with center horizontal graticule. Connect a continuously variable DC source simultaneously to the Vertical inputs of the Display and a lab grade scope. Adjust input voltage for exactly +4 volts according to lab scope. Adjust Display Vertical GAIN vernier control on front panel for [illegible]tly 4 divisions deflection. Now [illegible]st input voltage over center 10 divisions in 1 volt steps according to lab scope. Find maximum error between calibrated voltage level and Display graticule lines. The maximum error distance at any point on the horizontal line divided by 12 divisions yields the percentage error. This should be less than 5%.

4.4.9 Horizontal Linearity Adjustment

Turn INTENSITY fully counterclockwise. Turn AUTO BLANKING off. Apply an AC signal to the scope Vertical input and turn up INTENSITY until trace is visible. Adjust Vertical GAIN so that line extends exactly 12 divisions. Adjust Horizontal POSITION control until line exactly coincides with center vertical graticule. Connect a continuously variable DC source simultaneously to the Horizontal input of the Display and the Vertical input of a lab grade scope. Adjust input voltage for exactly +0.2 volts according to lab scope. Adjust Horizontal GAIN control for exactly 2 divisions deflection. Adjust input voltage for 0.7 volts. Adjust Adj. 3 (Figure 4-5) for exactly 7 divisions deflection from center line. Adjust input voltage across entire scope face in 0.1 volt steps, according to the lab scope. Find maximum error between calibrated voltage level and Display graticule line. The maximum error distance at any point on the vertical line divided by 16 divisions yields the percentage error. This should be less than 3%.

4.4.10 "Z" Marker Amplifier Check

Apply a 100 Hz signal to the Display Horizontal input. Adjust signal for 16 divisions deflection. Set marker INTENSITY fully clockwise. Apply a series of positive pulses to the "Z" marker input. These pulses should be approximately 1 kHz, 10 microseconds in duration and 2 volts in amplitude. Resultant signal at wiper of R408 should be a negative going pulse from about +35 V to +3 volts.

Now change the input signal to apply negative pulses of the same specifications. The signal at the wiper of R408 should still be a negative going pulse. The amplitude will be slightly larger (34 V) than with positive pulses.

CAUTION: Applying an input to the "Z" marker circuit without a signal in the Display Horizontal, will burn the CRT phosphor. The AUTO BLANKING circuit does not protect the CRT in this instance.

4.4.11 "Y" Marker Input Check

Maintain setup of section 4.4.10 with these exceptions: Disconnect pulse source from "Z" input and connect to "Y" marker input. Reduce pulse amplitude to 0.4 volts. Turn "Y" marker SIZE pot fully clockwise. The POLARITY switch should be in the + position.

Check signal at pin 7 of IC201B T.P. 9, (Figure 4-5). The pulse amplitude should be approximately 5 V. The DC offset at this point can be adjusted by the Vertical POSITION control. The polarity of this pulse will be the same as that of the input pulse. Switch the POLARITY switch to -. The signal at T.P. 9 will have the opposite polarity of the input signal. The amplitudes of either polarity at this point will be approximately the same. The signal on the scope face will be about 1.5 div with the above input signal. Putting a larger signal into the unit causes the displayed pulse markers to change in amplitude when the polarity is reversed on the back panel.

4.4.12 Vertical Polarity Check

Apply an AC signal to Display Horizontal input. Place line 4 divisions above center with channel A POSITION control. Switch VERT POLARITY switch from NORM to INVERT. The line should now be 4 divisions below the center line. Return to NORM. Repeat for channel B.

4.5 TROUBLESHOOTING

Troubleshooting is generally a systematic procedure of "divide and conquer". A thorough understanding of the block diagram and the circuit description located in Section 3 and the calibration procedure located in section 4.4 of this manual will enable the trouble symptom to be associated with a particular circuit or component.

Equipment troubles are frequently due simply to improper front or rear panel control settings. Refer to the operating instructions in Section 2 for complete explanation of each control's function along with typical operating instructions. If in doubt, also use the controls to help isolate a trouble to a specific area of the instrument.

After verifying that trouble is not improper setting of the controls or test setup, make a thorough check of the instrument's performance by following the calibration procedure in Section 4.4. By following the calibration procedure, a trouble can be localized to a specific circuit or component. After localizing a trouble to a specific area of the unit, make a good visual check of the area. Check for burned or broken components, loose wires or circuit-board connections.

After localizing the problem, voltage and resistance checks will help find the defective component.

When troubleshooting and circuit tracing, care must be taken to not short one of the higher voltage supplies to the ±15.5 volt supplies. If this should occur, it can damage the op amps. If trouble is suspected in the high-voltage circuit, the assembly can be disconnected from the main board and another high-voltage assembly substituted for the suspected defective one. When removing components from the printed-circuit board, do not

use excessive heat. This can damage the lands on the printed-circuit board. If the defective component is the CRT, use extreme care in replacing it. To prevent personal injury, always wear a face mask or goggles and protective gloves.

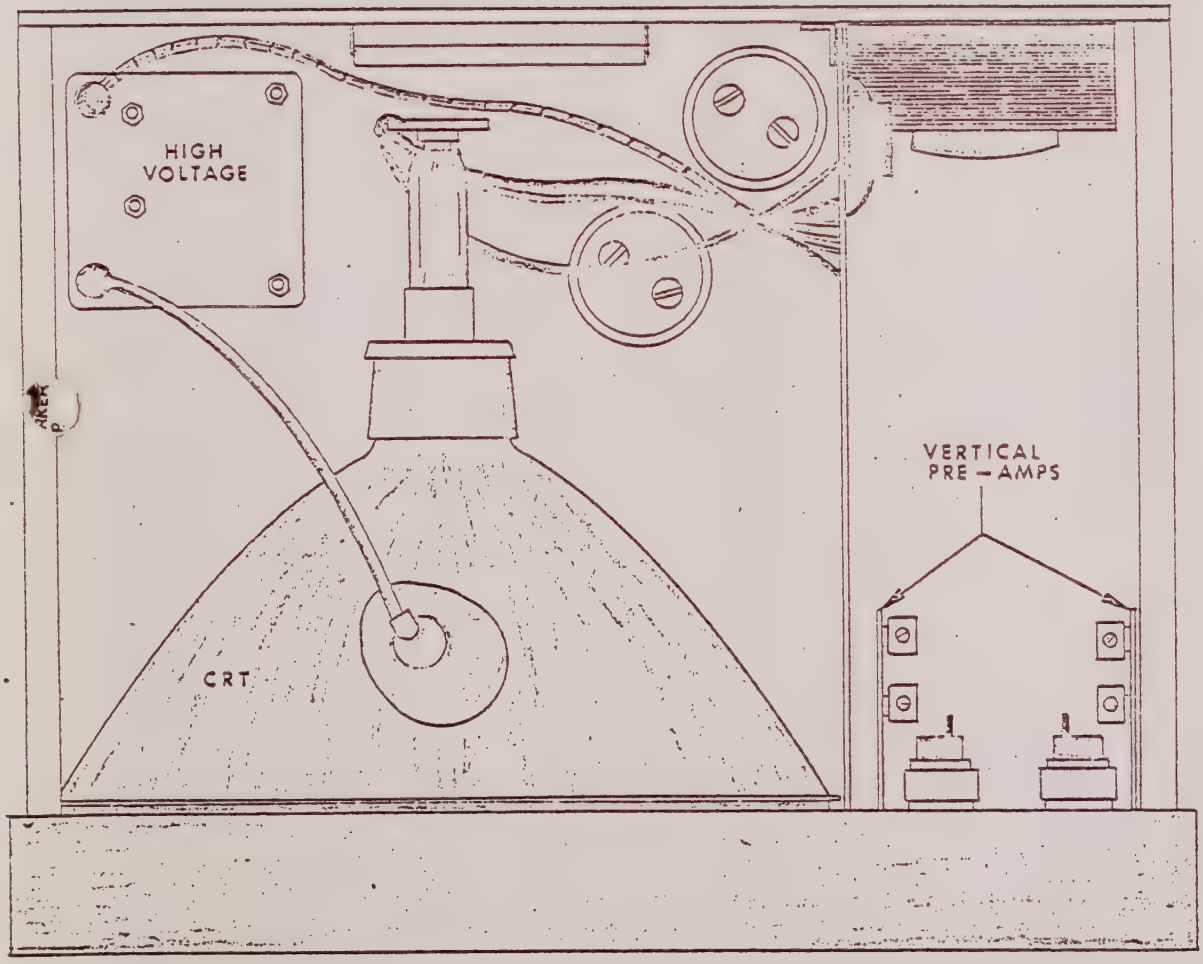


Figure 4-6. Wavetek Display Top View

SECTION 5

SCHEMATICS AND PARTS LISTS

5.1 INTRODUCTION - This section contains all schematics and a list of replaceable parts for the instrument. In an assembly containing one or more subassemblies, the assembly parts list is divided to separate the subassemblies. The subassembly three-digit circuit reference on the schematic is represented in the REFERENCE SYMBOL column by the last one or two digits. The first digit represents the subassembly on which the part is located. The subassembly (100, 200 . . .) is indicated next to the reference symbol heading. Also included are the Wavetek code for component manufacturer, an explanation of schematic symbols, and a list of abbreviations used in the text.

5.2 MANUFACTURER'S CODE - The following code is used on the parts list to identify the manufacturer.

A-B	Allen-Bradley	Milwaukee, Wisconsin
ACI	Advance Components, Inc.	Centerbrook, Connecticut
A-D	Analog Devices	Norwood, Massachusetts
AER	AVX	Myrtle Beach, South Carolina
A-I	Alan Industries	Columbus, Indiana
AIN	Alpha Industries, Inc.	Woburn, Massachusetts
ALC	Alco Electronics Products, Inc.	Lawrence, Massachusetts
AMP	AMP, Inc.	Harrisburg, Pennsylvania
APL	Amphenol	Danbury, Connecticut
A-P	American Plasticraft (APCO)	Chicago, Illinois
APX	Amperex	Slatersville, Rhode Island
ARC	ARCO Electronics	Great Neck, New York
ASZ	Airco Speer Electronics	Nogales, Arizona
AVT	Avantek	Santa Clara, California
BEI	Beckman Instruments, Inc.	Fullerton, California
BEL	Belden	Chicago, Illinois
BER	Berg Electronics	New Cumberland, Pennsylvania
BOU	Bourns	Riverside, California
BUS	Bussman	St. Louis, Missouri
CAM	Cambion	Cambridge, Massachusetts
CAR	Carling Electric, Inc.	West Hartford, Connecticut
C-D	Cornell Dubilier	Newark, New Jersey
C-E	Clinton Electronics	Rockford, Illinois
CGW	Corning Glass Works	Corning, New York
CHE	Cherry Electrical Products, Prod.	Waukegan, Illinois
C-H	Cutler-Hammer	Milwaukee, Wisconsin
C-I	Components Incorporated	Biddeford, Maine
C-J	Cinch Jones	Elk Grove Village, Illinois
C-K	C & K Components	Watertown, Massachusetts
CKI	CTS Knight, Inc.	Sandwich, Illinois
C-L	Centralab	Milwaukee, Wisconsin
CLA	Clairex Electronics	Mount Vernon, New York
CTS	Chicago Telephone Systems	Elkhart, Indiana
C-W	C-W Industries	Philadelphia, Pennsylvania
DAL	Dale Technology Corp.	Hartsdale, New York
DEL	Delevan	East Aurora, New York
DIO	Diodes, Inc.	Chatsworth, California
DRA	Drake Mfg. Company	Harwood Heights, Illinois
ETP	Erie Technological Prod., Inc.	Erie, Pennsylvania
FCD	Fairchild	Mountain View, California

MANUFACTURER'S CODE (CONT'D)

HHS	Herman H. Smith, Inc.	Brooklyn, New York
H-P	Hewlett-Packard	Palo Alto, California
HEY	Heyman Mfg. Company	Kenilworth, New Jersey
HIT	Hitachi America Ltd.	Chicago, Illinois
IRC	International Resistance Co.	Philadelphia, Pennsylvania
INT	Intersil Inc.	St. Palos Heights, Illinois
ITT	International Telephone & Telegraph.	West Palm Beach, Florida
JEF	Jeffers	Dubois, Pennsylvania
JON	E.F. Johnson Company.	Waseca, Minnesota
KEM	Kemtron Electron Products Inc.	Newburyport, Massachusetts
KID	Kidco, Inc	Medford, New Jersey
LIT	Littelfuse	Des Plaines, Illinois
M-A	Microwave Associates.	Burlington, Massachusetts
MAL	Mallory	Indianapolis, Indiana
M-O	Marko-Oak	Anaheim, California
MOL	Molex	Downers Grove, Illinois
MOT	Motorola	Phoenix, Arizona
NAT	National Semiconductor Corp.	Santa Clara, California
N-T	National Teltronics	Laredo, Texas
P-B	Potter & Brumfield	Princeton, Indiana
POM	Pomona Electronics	Pomona, California
Q-C	Quality Components	St. Marys, Pennsylvania
RAY	Raytheon	Burlington, Massachusetts
RCA	RCA	Harrison, New Jersey
RMC	Radio Material Company	Chicago, Illinois
SCC	Stackpole Carbon Company	St. Marys, Pennsylvania
SEL	Sealectro	Mamaroneck, New York
SEM	Semtech	Newbury Park, California
S-G	Standard Grigsby	Aurora, Illinois
SGM	Sigma	Braintree, Massachusetts
SIG	Signetics Corporation	Sunnydale, California
S-I	Switchcraft, Inc.	Chicago, Illinois
SPE	Spectrol	City of Industry, California
SPR	Sprague	North Adams, Massachusetts
S-T	Sarkes Tarzian,	Bloomington, Indiana
STR	Stettner & Co.	Nurnburg, West Germany
SYL	Sylvania	Woburn, Massachusetts
THR	Thermalloy, Co.	Dallas, Texas
T-I	Texas Instruments	Dallas, Texas
TRW	TRW Capacitor Division	Ogallala, Nebraska
VAR	Varadyne Capacitor Division	Dallas, Texas
W-E	Wells Electronics	South Bend, Indiana
W-I	Wavetek, Indiana Inc.	Beech Grove, Indiana
WSD	Wavetek, San Diego	San Diego, California

5.3 SCHEMATIC NOTES - The following notes and abbreviations pertain to all schematics. Additional notes pertaining to specific schematics are included on each schematic if required.

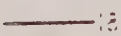
All resistor values are shown in ohms unless otherwise specified.
All capacitor values are shown in picofarads (pF) unless otherwise specified.
All inductor values are shown in microhenries (µH) unless otherwise specified.

Denotes DC voltage reading in volts unless otherwise specified.

Denotes high impedance crystal detector reading in volts unless otherwise specified.

Denotes 50 ohm crystal detector reading in volts unless otherwise specified.

Signal or voltage source.



Connects to indicated signal or voltage source.

Arrow indicates clockwise rotation of wiper.

Coaxial jack

Coaxial plug

Coaxial cable

Factory adjusted part.

Denotes a front-panel device.

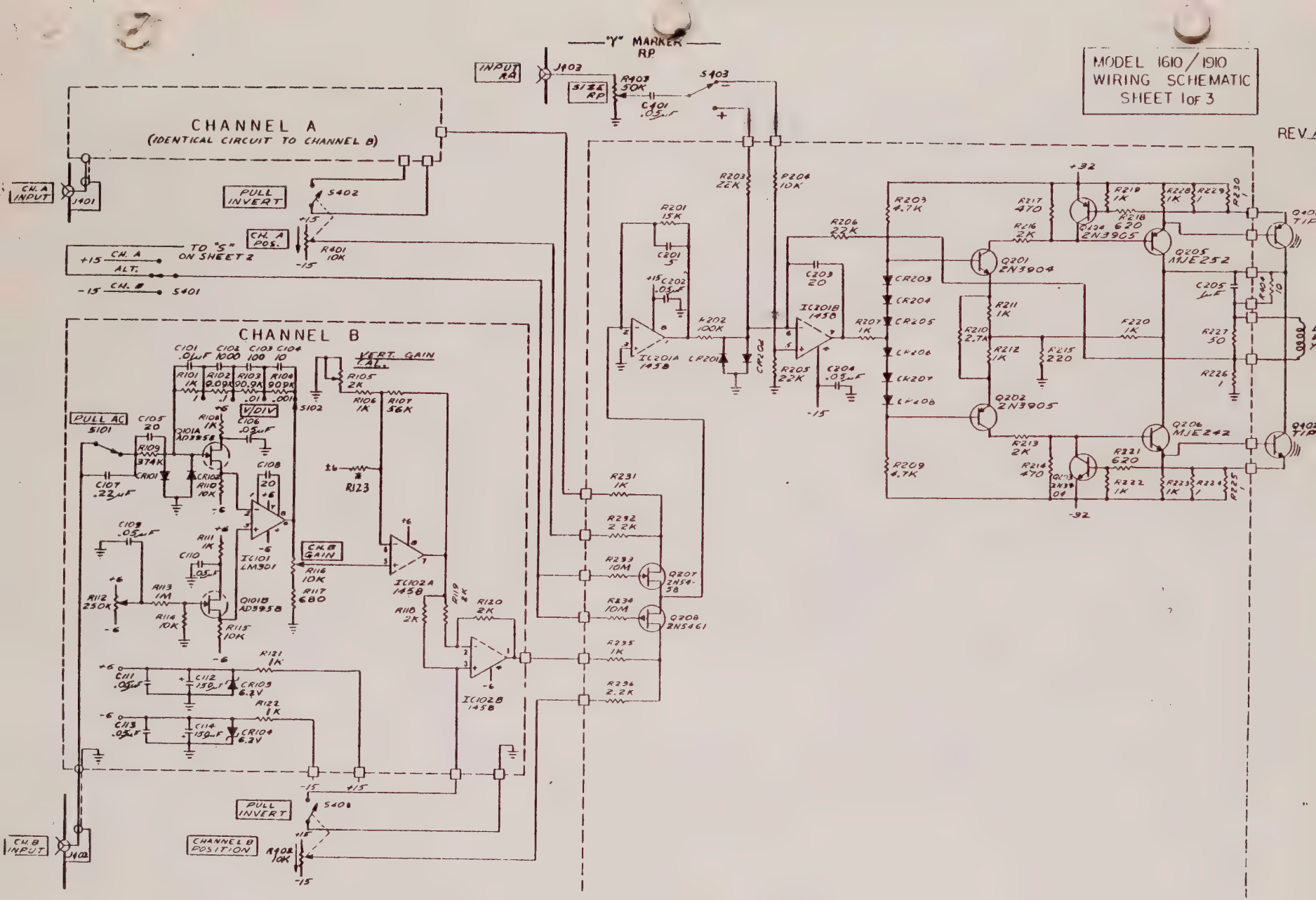
Denotes a rear-panel device.

Denotes a PC board adjustment or accessible module adjustme

Denotes an internal module adjustment not accessible without removing module cover.

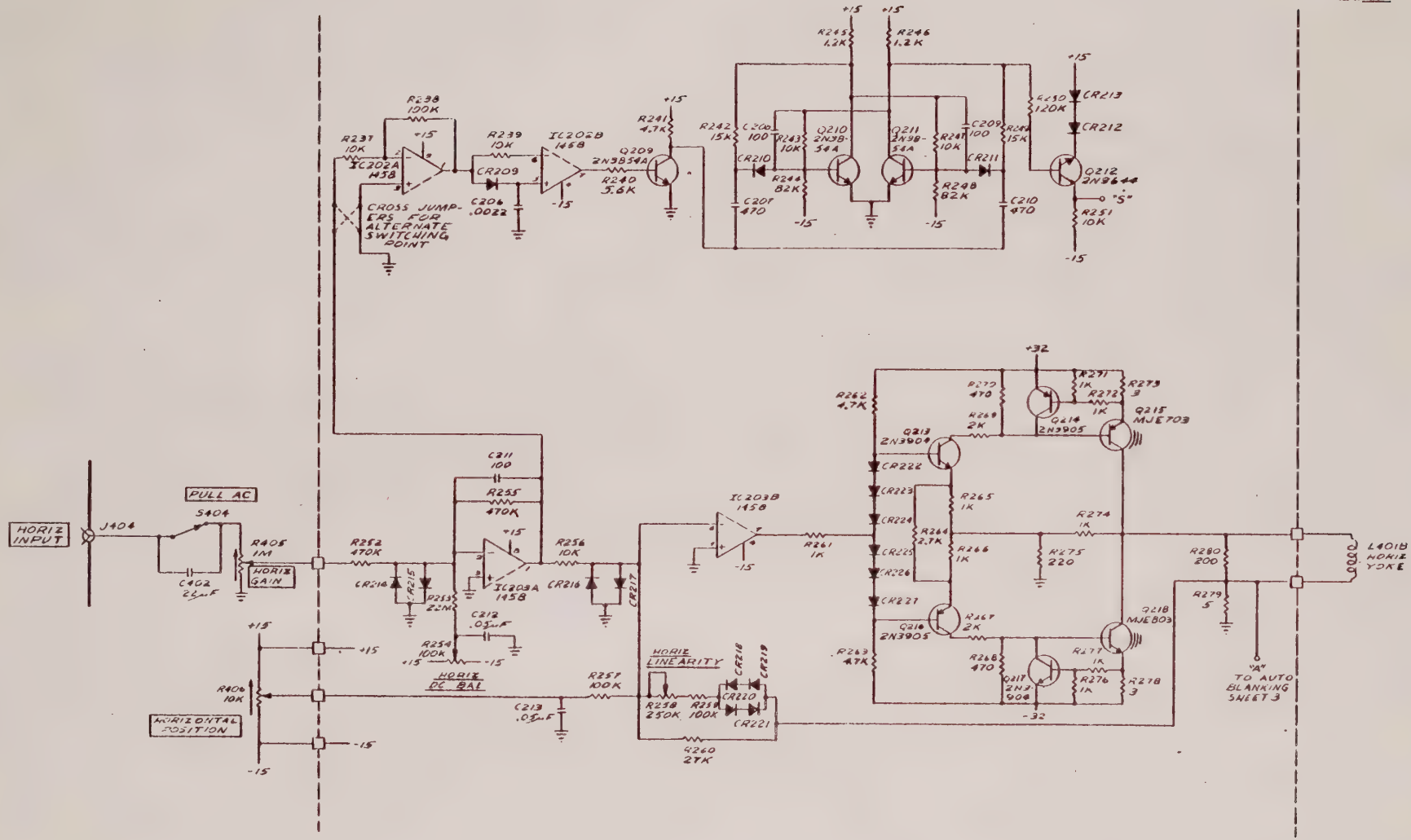
5.4 ABBREVIATION CODE

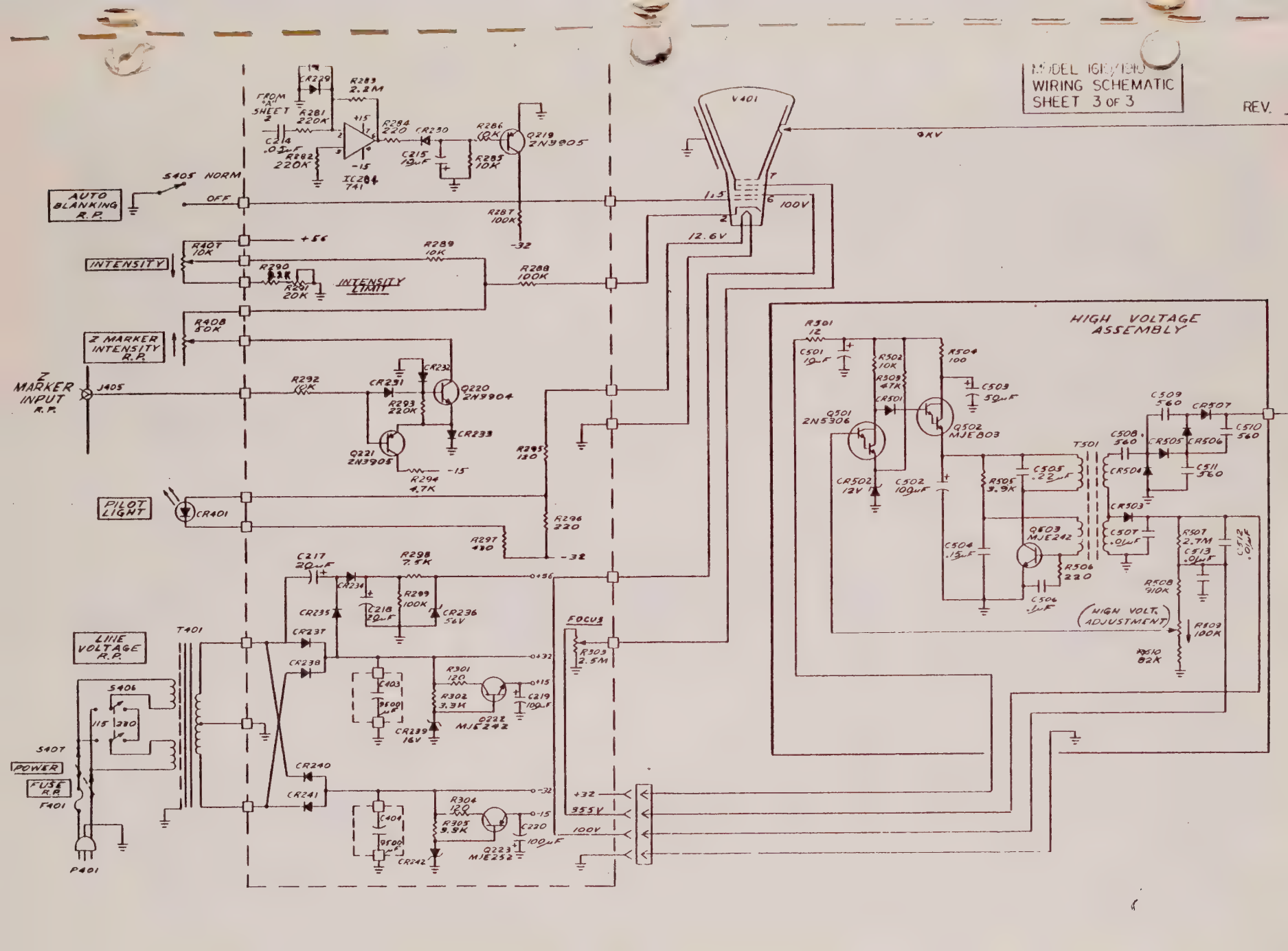
A	ampere	K	relay	Ω	ohm
AC	alternating current	kHz	kilohertz	P	plug
C	capacitor	kΩ	kilohm	pp	peak-to-peak
CR	diode	kV	kilovolt	pF	picofarad
dB	decibel	kW	kilowatt	Q	transistor
dBm	decibel referred to 1 mW	L	inductor	R	resistor
dBmV	decibel referred to 1 mV	MHz	megahertz	RF	radio frequency
DC	direct current	MΩ	megohm	RMS	root-mean-square
DS	indicating device, lamp	µF	microfarad	R.P.	rear panel
F	farad	µA	microampere	S	switch
F.P.	front panel	µH	microhenry	T	transformer
H	henry	M	meter	TP	test point
Har	harmonic	mA	milliampere	V	volt
Hz	hertz	mH	millihenry	VA	voltampere
IC	integrated circuit	mV	millivolt	W	watt
IF	intermediate frequency	mW	milliwatt	X	crystal
J	jack				


MODEL 1610 / 1910
WIRING SCHEMATIC
SHEET 1 of 3
REV. A
"Y" MARKER RP
INPUT AA
J103
R403 50K SIZE RP
S103
C401 .03µF
CHANNEL A
(IDENTICAL CIRCUIT TO CHANNEL B)
CH. A INPUT
J101
PULL INVERT
S402
CH. A POS.
R401 10K
+15
-15
TO "S" ON SHEET 2
CH. A ALT.
CH. B
S401
CHANNEL B
PULL AC S101
C105 20
R109 374K
CR101
C107 .22µF
C101 .01µF
C102 1000
C103 100
C104 10
R101 1K
R102 9.09K
R103 909K
R104 90.9K
C108 20
C109 .05µF
C110 .05µF
R111 1K
R112 250K
R113 1M
R114 10K
R115 10K
Q101A AD3958
Q101B AD3958
IC101 LM301
R108 1K
C106 .05µF
V/DIV
S102
R105 2K
R106 1K
R107 56K
VERT GAIN ADJ.
R123
CH. B GAIN
R116 10K
R117 680
IC102A 1458
IC102B 1458
R118 2K
R119 2K
R120 2K
R121 1K
R122 1K
C111 .05µF
C112 150µF
C113 .05µF
C114 150µF
CR103 6.2V
CR104 6.2V
PULL INVERT
S401
CHANNEL B POSITION
R402 10K
CH. B INPUT
J102
R231 1K
R232 2.2K
R233 10M
R234 10M
R235 1K
R236 2.2K
Q207 2N5486
Q208 2N5461
R201 15K
C201 5
C202 .03µF
IC201A 1458
IC201B 1458
R202 100K
R203 22K
R204 10K
R205 22K
C203 20
C204 .03µF
R206 22K
R207 1K
CR201
CR202
CR203
CR204
CR205
CR206
CR207
CR208
R208 4.7K
R209 4.7K
R210 2.7K
R211 1K
R212 1K
R213 2K
R214 470
R215 220
R216 2K
R217 470
R218 620
R219 1K
R220 1K
R221 620
R222 1K
R223 1K
R224 1
R225 1
R226 1
R227 50
R228 1K
R229 1
R230 1
Q201 2N3904
Q202 2N3905
Q203 2N3906
Q204 2N3906
Q205 MJE252
Q206 MJE242
C205 µF
+32
-32

MODEL 1610/1910
WIRING SCHEMATIC
SHEET 2 OF 3

REV. A




MODEL 161/1610
WIRING SCHEMATIC
SHEET 3 OF 3
REV.
V401
9KV
AUTO BLANKING R.P.
S405 NORM
OFF
INTENSITY
Z MARKER INTENSITY R.P.
Z MARKER INPUT R.P.
J405
PILOT LIGHT
CR401
LINE VOLTAGE R.P.
S406
115
230
S407
POWER
FUSE R.P.
F401
P401
T401
FROM "A" SHEET 2
A281 220K
R283 2.2M
R284 220
R282 220K
IC204 741
CR229
CR230
CR215
Q219 2N3905
R286 10K
R285 10K
R287 100K
-32
+56
R407 10K
R289 10K
R290 3.3K
R291 20K
INTENSITY LIMIT
R288 100K
R408 50K
R292 10K
CR231
CR232
CR233
Q220 2N3904
R293 220K
Q221 2N3905
R294 4.7K
-15
R295 130
R296 220
R297 430
-32
C217 20μF
R298 7.5K
CR234
C218 20μF
R299 100K
CR236 56V
CR235
CR237
CR238
CR239 16V
C403 .05μF
R301 120
R302 3.3K
Q222 MJE242
C219 100μF
+15
+32
CR240
CR241
CR242
C404 .05μF
R304 120
R305 9.5K
Q223 MJE252
C220 100μF
-15
-32
FOCUS
R303 2.5M
+32
355V
100V
115
100V
12.6V
HIGH VOLTAGE ASSEMBLY
R501 12
C501 10μF
R502 10K
R503 47K
CR501
Q501 2N5306
CR502 12V
R504 100
C503 50μF
Q502 MJE803
C502 100μF
R505 3.9K
C505 .22μF
C504 .15μF
Q503 MJE242
R506 220
C506 .1μF
T501
C508 560
CR505
CR506
C509 560
CR507
C510 560
CR504
C511 560
CR503
C507 .01μF
R507 2.7M
C513 .01μF
C512 .01μF
R508 910K
R509 100K
R510 82K
(HIGH VOLT. ADJUSTMENT)

PARTS LIST

1610/1910 Chassis REV C

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"C 400"	CAPACITORS				
1	Ceramic Disc, .05 µF 100 V ±20%	CD103-350	SPR	TG-S50	1
2	Mylar Paper, .22 µF 200 V ±10%	CP101-422	C-D	WMF2P22	1
3,4	Electrolytic, 9500 µF 50 V	CE117-205	MAL	CG952U-050EFH3	2
"CR 400"	DIODES				
1	Light Emitting Diode & Mounting Kit	DL000-001	NAT	NSL102	1
"F 400"	FUSES				
1	Fuse	MF000-002	BUS	MDL2	1
"J 400"	CONNECTORS (JACKS)				
1,2,3	BNC, Receptacle	JB106-250	APL	UG625/U	5
	CRT, Socket	MC000-061	A-P	321-7	1
"L 400"	INDUCTORS				
1	Deflection Yoke	LY000-001	W-I	LY000-001	1
"P 400"	CONNECTORS (PLUGS)				
1	AC Plug/Cord Assembly	WL009-088	BEL	17405-S	1
"Q 400"	TRANSISTORS				
1	PNP, Silicon, Power	QB000-030	T-I	TIP36C	1
2	NPN, Silicon, Power	QB000-029	T-I	TIP35C	1
"R 400"	RESISTORS				
1,2	Variable Carbon, 10 Kilohm & push-open switch	RP135-310	CTS	K1-45	2
3,8	Variable Carbon, 50 Kilohm	RP124-350	A-B	R6V	2
4	Wire Wound, 10 ohm 50 W	RM105-010	OHM	0400B	1
5	Variable Carbon, 1 Megohm & push-close switch	RP134-510	W-I	RP134-510	1
6,7	Variable Carbon, 10 Kilohm	RP102-310	W-I	RP102-310	2
"S 400"	SWITCHES				
1	Rotary 1 pole - 3 position	SR000-022	ALC	MRA3-3	1
2	Part of R401 Assembly	---------	---	------	-
3,5	Miniature Toggle SPDT	ST001-006	C-K	7101P	2
4	Part of R405 Assembly	---------	---	------	-
6	Slide DPDT	SS000-003	S-I	46256LFE	1
7	Toggle DPST	ST000-009	C-H	7561K4	1
8	Part of R402 Assembly	---------	---	------	-
"T 400"	TRANSFORMERS				
1	Power Transformer, 115/230 V x 50 VCT	TT000-026	W-I	TT000-026	1
	TUBES				
I	Cathode Ray Tube, P1 Phosphor	VV001-004	C-E	CE387-M12P1	1
	Cathode Ray Tube, P4 Phosphor	VV004-004	C-E	CE387-M12P4	-
	Cathode Ray Tube, P7 Phosphor	VV007-004	C-E	CE387-M12P7	-
	MISCELLANEOUS				
	Fuse Holder	MF000-001	LIT	345001	1

PARTS LIST

1610/1910
HIGH VOLTAGE

REV B

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"C 500"	CAPACITORS				
1	Electrolytic, 10 µF 50 V	CE107-010	SPR	TE-1304	1
2	Electrolytic, 100 µF 25 V	CE105-110	SPR	TE-1211	1
3	Electrolytic, 50 µF 50 V	CE107-050	SPR	TE-1307	1
4	Mylar Paper, .15 µF ±10% 100 V	CP103-415	C-D	WMF-1P15	1
5	Mylar Paper, .22 µF ±10% 200 V	CP101-422	C-D	WMF-2P22	1
6	Mylar Paper, .1 µF ±10% 200 V	CP101-410	C-D	WMF-2P1	1
7,12,13	Ceramic Disc, .01 µF ±20% 1 kV	CD102-310	SPR	5GA-S10	3
8,9,10,11	Ceramic Disc, 560 pF ±10% 6 kV	CD111-156	A-E	6CCD561	4
"CR 500"	DIODES				
1	Silicon Junction, 400 PIV 3/4 amp	DR000-001	DIO	1N4004	1
2	Zener, 12 V ±10%	DB000-003	C-L	ZD12A	1
3,4,5,6,7	Silicon, High Voltage 7 kV PIV	DR000-010	SEM	SMC70	5
"P 500"	CONNECTORS (PLUGS)				
1	6 pin	MC000-062	MOL	09-08-4063	1
	Contact, male, for above	MC000-063	MOL	02-09-8104	4
"Q 500"	TRANSISTORS				
1	NPN, Silicon, Darlington	QA053-060	G-E	2N5306	1
2	NPN, Silicon, Darlington	QB000-025	MOT	MJE803	1
3	NPN, Silicon	QB000-023	MOT	MJE242	1
"R 500"	RESISTORS				
1	Composition, 12 ohm ±10% ½ W	RC106-012	A-B	EB1201	1
2	Composition, 10 Kilohm ±10% ¼ W	RC104-310	A-B	CB1031	1
3	Composition, 47 Kilohm ±10% ¼ W	RC104-347	A-B	CB4331	1
4	Wire Wound, 100 ohm ±5% 5 W	RM104-110	SPR	243E1015	1
5	Composition, 3.9 Kilohm ±10% ¼ W	RC104-239	A-B	CB3921	1
6	Composition, 220 ohm ±10% ¼ W	RC104-122	A-B	CB2211	1
7	Composition, 2.7 Megohm ±5% ½ W	RC105-527	A-B	EB2755	1
8	Composition, 910 Kilohm ±5% ¼ W	RC103-491	A-B	CB9145	1
9	Variable Cermet, 100 Kilohm	RP131-410	CTS	360T104B	1
10	Composition, 82 Kilohm ±5% ¼ W	RC103-382	A-B	CB8231	1
"T 500"	TRANSFORMERS				
1	Transformer, High Voltage	TT000-028	W-I	TT000-028	1
	MISCELLANEOUS				
	Anode Lead	MC000-060	N-T	239-12	1
	Teflon Turret Terminals	HT115-000	SEL	RSTSM21-TUR	5

PARTS LIST

1610/1910 Board REV B

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"C 200"	CAPACITORS				
1	Ceramic Disc, 5 pF 1 kV ±5%	CD101-R50	SPR	10TCC-V50	1
2,4,12,13, 14	Ceramic Disc, .05 µF 100 V ±20%	CD103-350	SPR	TG-S50	5
3	Ceramic Disc, 20 pF 1 kV ±5%	CD101-020	SPR	10TCC-020	1
5	Mylar Paper, 1 µF	CP103-510	SPR	225P	1
6	Mylar Paper, .0022 µF	CP101-222	C-D	WMF2022	1
7,10	Ceramic Disc, 470 pF	CD102-147	SPR	5GA-T47	2
8,9,11	Ceramic Disc, 100 pF 1 kV ±5%	CD104-110	SPR	10TCU-T10	3
15	Electrolytic, 10 µF 25 V	CD105-010	SPR	TE-1204	1
17,18	Electrolytic, 20 µF 250 V	CE109-020	C-D	BR20-250	2
19,20	Electrolytic, 100 µF 25 V	CE105-110	SPR	TE-1211	2
"CR 200"	DIODES				
1,2,3,4,5,6, 7,8,10,11, 14,15,16, 17,22,23, 24,25,26, 27,28,29	Silicon, Computer Diode	DG109-140	G-E	1N914	22
9	Germanium, Point Contact	DG100-341	HIT	1N34AS	1
12,13,18,19, 20,21,30, 31,32,33, 34,35	Silicon Junction, 400 PIV 3/4 amp.	DR000-001	DIO	1N4004	12
36	Zener, 56 V	DB000-013	C-L	1N5263	1
37,38,40,41	Silicon,Junction, 200 V PIV 3 amp.	DR000-009	G-E	1N5624	4
39,42	Zener, 16 V	DB000-012	MOT	1N4745A	2
"IC 200"	INTEGRATED CIRCUITS				
1,2,3	Dual Operational Amplifier	IC000-005	MOT	MC1458	3
4	Operational Amplifier	IC000-002	SIG	N5741V	1
"J 201"	CONNECTOR (JACK)	MC000-064	MOL	02-09-7101	-
"R 200"	RESISTORS				
1,42,49	Composition, 15 Kilohm ±10% ¼ W	RC104-315	A-B	CB1531	3
2,38,57,59, 87,88,99	Composition, 100 Kilohm ±10% ¼ W	RC104-410	A-B	CB1041	7
3,5,6	Composition, 22 Kilohm ±10% ¼ W	RC104-322	A-B	CB2231	3
4,37,39,43, 47,51,56, 85,86,89, 90,92	Composition, 10 Kilohm ±10% ¼ W	RC104-310	A-B	CB1031	12
7,23,28,31, 35,61	Composition, 1 Kilohm ±10% ¼ W	RC104-210	A-B	CB1021	6
8,9,41,62, 63,94	Composition, 4.7 Kilohm ±10% ¼ W	RC104-247	A-B	CB4721	6
10,64	Composition, 2.7 Kilohm ±10% ¼ W	RC104-227	A-B	CB2721	2
11,18,19,22; 66,71, 72,76,77	Composition, 1 Kilohm ±5% ¼ W	RC103-210	A-B	CB1025	10

PARTS LIST

1610/1910 Board REV B

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"R 200"	RESISTORS (Cont'd)				
13,16,67,69	Composition, 2 Kilohm ±5% ¼ W	RC103-220	A-B	CB2021	4
14,17,68,70	Composition, 470 ohm ±5% ¼ W	RC103-147	A-B	CB4711	4
15,75	Composition, 220 ohm ±5% ½ W	RC105-122	A-B	EB2211	2
18,21	Composition, 620 ohm ±5% ¼ W	RC103-162	A-B	CB6215	2
20,74	Composition, 1 Kilohm ±10% 2 W	RC110-210	A-B	HB1021	2
24,25,29,30	Wire Wound, 1 ohm ±5% 5 W	RM104-R10	SPR	243E1R05	4
26	Wire Wound, 1 ohm ±5% 10 W	RM103-R10	SPR	247E1R05	1
27	Wire Wound, 50 ohm ±5% 10 W	RM103-050	SPR	247E5005	1
32,36	Composition, 2.2 Kilohm ±10% ¼ W	RC104-222	A-B	CB2221	2
33,34	Composition, 10 Megohm ±10% ¼ W	RC104-610	A-B	CB1061	2
40	Composition, 5.6 Kilohm ±10% ¼ W	RC104-256	A-B	CB5621	1
44,48	Composition, 82 Kilohm ±10% ¼ W	RC104-382	A-B	CB8231	2
45,46	Composition, 1.2 Kilohm ±10% ¼ W	RC104-212	A-B	CB1221	2
50	Composition, 120 Kilohm ±10% ¼ W	RC104-412	A-B	CB1241	1
52	Composition, 470 Kilohm ±10% ½ W	RC106-447	A-B	EB4741	1
53	Composition, 22 Megohm ±10% ¼ W	RC104-622	A-B	CB2261	1
54	Variable Cermet, 100 Kilohm	RP131-410	CTS	360T104B	1
55	Composition, 470 Kilohm ±10% ¼ W	RC104-447	A-B	CB4741	1
58	Variable Cermet, 250 Kilohm	RP131-425	CTS	360T254B	1
60	Composition, 27 Kilohm ±10% ¼ W	RC104-327	A-B	CB2731	1
73,78	Composition, 3 ohm ±5% 1 W	RC107-R30	A-B	GB3005	2
79	Wire Wound, 5.0 ohm ±5% 3 W	RM102-R50	SPR	242E5R05	1
80	Wire Wound, 200 ohm ±5% 10 W	RM103-120	SPR	247E2015	1
81,82,93	Composition, 220 Kilohm ±10% ¼ W	RC104-422	A-B	CB2241	3
83	Composition, 2.2 Megohm ±10% ¼ W	RC104-522	A-B	CB2251	1
84	Composition, 220 ohm ±10% ¼ W	RC104-122	A-B	CB2211	1
91	Variable Cermet, 20 Kilohm ±10% ¼ W	RP131-320	CTS	360T203B	1
95	Composition, 120 ohm ±5% 2 W	RC109-112	A-B	HB1215	1
96	Composition, 220 ohm ±5% 2 W	RC109-122	A-B	HB2215	1
97	Composition, 430 ohm ±5% ½ W	RC105-143	A-B	EB4315	1
98	Composition, 7.5 Kilohm ±5% 1 W	RC107-275	A-B	GB7525	1
"R 300"					
1,4	Composition, 120 ohm ±10% 2 W	RC110-112	A-B	HB1211	2
2,5	Composition, 3.3 Kilohm ±10% ¼ W	RC104-233	A-B	CB3321	2
3	Variable Carbon, 2.5 Megohm	RP138-525	W-I	RP138-525	1
"Q 200"	TRANSISTORS				
1,3,13,17, 20	NPN, Silicon	QA039-040	NAT	2N3904	5
2,4,14,16, 19,21	PNP, Silicon	QA039-050	NAT	2N3905	6
5,23	PNP, Silicon, Power	QB000-022	MOT	MJE252	2
6,22	NPN, Silicon, Power	QB000-023	MOT	MJE242	2
7	N-channel, JFET	QA054-580	MOT	2N5458	1
8	P-channel, JFET	QA054-610	MOT	2N5461	1
9,10,11	NPN, Silicon	QA038-541	G-E	2N3854A	3
12	PNP, Silicon	QA036-440	FCD	2N3644	1
15	PNP, Silicon Power Darlington	QB000-024	MOT	MJE703	1
18	NPN, Silicon Power Darlington	QB000-025	MOT	MJE803	1

PARTS LIST

1610/1910
VERTICAL PRE-AMP

REV C

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"C 100"	CAPACITORS				
1	Paper, .01 µF	CP104-310	SPR	192P1039R8	2
2	Duramica, 1000 pF	CM101-210	A-E	DM19-102J	2
3	Ceramic Disc, 100 pF ±5%	CD104-110	SPR	10TCU-T10	2
4	Ceramic Disc, 10 pF ±5%	CD101-010	SPR	10TCC-010	2
5,8	Ceramic Disc, 20 pF	CD101-020	SPR	10TCC-Q20	4
6,9,10,11, 13	Ceramic Disc, .05 µF 100 V ±20%	CD103-350	SPR	TG-S50	10
7	Mylar Paper, .22 µF 200 V ±10%	CP101-422	C-D	WMF2P22	2
12,14	Electrolytic, 150 µF 10 V	CE115-150	SPR	Type 503	4
"CR 100"	DIODES				
1,2	Silicon, Computer Diode	DG109-140	G-E	1N914	4
3,4	Zener, 6.2 V	DB000-011	MOT	1N4735	4
"IC 100"	INTEGRATED CIRCUITS				
1	Operational Amplifier	IC000-008	NAT	LM301AN	2
2	Dual Operational Amplifier	IC000-005	MOT	MC1458	2
"R 100"	RESISTORS				
1	Metal Film, 1.00 Kilohm ±1% 1/8 W	RF212-100	CGW	RN55D	2
2	Metal Film, 9.09 Kilohm ±1% 1/8 W	RF212-909	CGW	RN55D	2
3	Metal Film, 90.9 Kilohm ±1% 1/8 W	RF213-909	CGW	RN55D	2
	Metal Film, 909 Kilohm ±1% 1/8 W	RF214-909	CGW	RN55D	2
5	Variable, 2 Kilohm	RP129-220	CTS	360S202B	2
6,8,11	Composition, 1.0 Kilohm ±10% ¼ W	RC104-210	A-B	CB1021	6
7	Composition, 56 Kilohm ±10% ¼ W	RC104-356	A-B	CB5631	2
9	Metal Film, 374 Kilohm ±1% 1/8 W	RF214-374	CGW	RN55D	2
10,15	Metal Film, 10.0 Kilohm ±1%	RF213-100	CGW	RN55D	4
12	Variable Cermet, 250 Kilohm ±20%	RP129-425	CTS	360S254B	2
13	Composition, 1 Megohm ±10% ¼ W	RC104-510	A-B	CB1051	2
14	Composition, 10 Kilohm ±10% ¼ W	RC104-310	A-B	CB1031	2
16	Variable Carbon, 10 Kilohm Part of S101	assembly	---	------	-
17	Composition, 680 ohm ±10% ¼ W	RC104-168	A-B	CB6811	2
18,19,20	Composition, 2 Kilohm ±5% ¼ W	RC103-220	A-B	CB2025	6
21,22	Composition, 1.0 Kilohm ±10% ¼ W	RC104-210	A-B	CB1021	4
23*	Factory Selected Value, if used	---------	---	------	-
"Q 100"	TRANSISTORS				
1	Dual "N" Channel JFET	QB000-026	A-B	AD3958	2
"S 100"	SWITCHES				
1,2	Switch/Potentiometer/Switch Assembly	SR000-027	W-I	SR000-027	2

MANUAL CHANGES

All Ocilloscopes

WAVETEK'S product improvement program incorporates the latest electronic developments into these instruments as rapidly as development and testing permit. Due to the time required to document and print these instruction manuals, it is not always possible to include the change information in the current printing. The following changes should be made to this manual:

CHANGES

1). Due to vendor changes, the wire connecting the CRT cathode and TP7 may be either a grey or a yellow wire. If a grey wire is used, no yellow wire will be present. If a yellow wire is used, no grey wire will be present.

2). On the CRT itself, pins 1 and 5 are internally shorted together, and either may be used to connect the CRT grid to the blanking cirucit.

www.manualsplus.com
1021836